Space Weather Technical Forecast

Issued on Tuesday, 12 July 2022 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1-R2 blackouts likely, slight chance of R3 blackouts. G1/Minor Storms likely, slight chance of G2/Moderate Storms Day 1 into Day 2 (12-13 July). Slight chance of S1 throughout, with slight chance of Active fluence later in period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low with just C-class flares in the last 24 hours. There are six numbered sunspots on the disc. AR3056 in the SE has been the most active recently, with a delta configuration in its leading penumbra. AR3055 and AR3053 are both large but with limited magnetic complexity. AR3057 in the NE is still difficult to see clearly but may have some complexity. All other regions are relatively simple and stable.
There are currently numerous large filaments on the Sun, with two large features in the southern hemisphere. There were limited signs of instability, however they will be monitored. No Earth-directed CMEs were observed in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, showed signs of weak CME effects, combined with a recent HSS arrival, likely from CH99. The wind speed was ambient for much of the period, rising steadily from 12/0530 UTC to reach near 470 km/s. The density was initially average, rising sharply at 11/1625 UTC when a CME likely arrived to peak at 22 ppcc. The IMF has been mostly moderate with some strong peaks of 17nT after the CME arrived and more recently when the HSS arrived. The north-south component was moderately southward directed at times for much of the period, then became more variable from 12/0500 UTC, varying between +-13 nT. The phi angle was largely positive (away from the Sun). The resultant geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, is now at background levels.
The high energy electron flux (greater than 2 MeV) remained at background levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold on a roughly level trend. Observed fluence was 2.08e6 integrated pfu at 12/0001 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on the 09 July may arrive either late on Day 1 (12 July) or early on Day 2 (13 July). The solar wind is currently at slightly elevated levels, likely under the influence of the HSS originating from CH99/+, but also perhaps with some transient influence. The HSS may be superseded by the expected arrival of the CME, perhaps increasing the solar wind to strong levels. Otherwise, winds are expected to reach elevated levels on Days 1 and 2 before slowly decreasing.
Overall geomagnetic activity is expected to be Unsettled to Active, with a Chance of G1/Minor Storms and a slight chance of G2/Moderate Storms with any CME effects. Geomagnetic activity

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then returning to mostly Quiet levels on Days 3 and 4 (14-15 July).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels. There is however a daily Slight Chance of S1 or greater, due to the presence of two relatively large sunspot regions on the centre disc, particularly as they are now moving across the western hemisphere.

The high energy electron flux (greater than 2MeV) may increase at the end of this period, but the any rise in fluence is expected to remain well below the Active threshold (1e8 integrated pfu).

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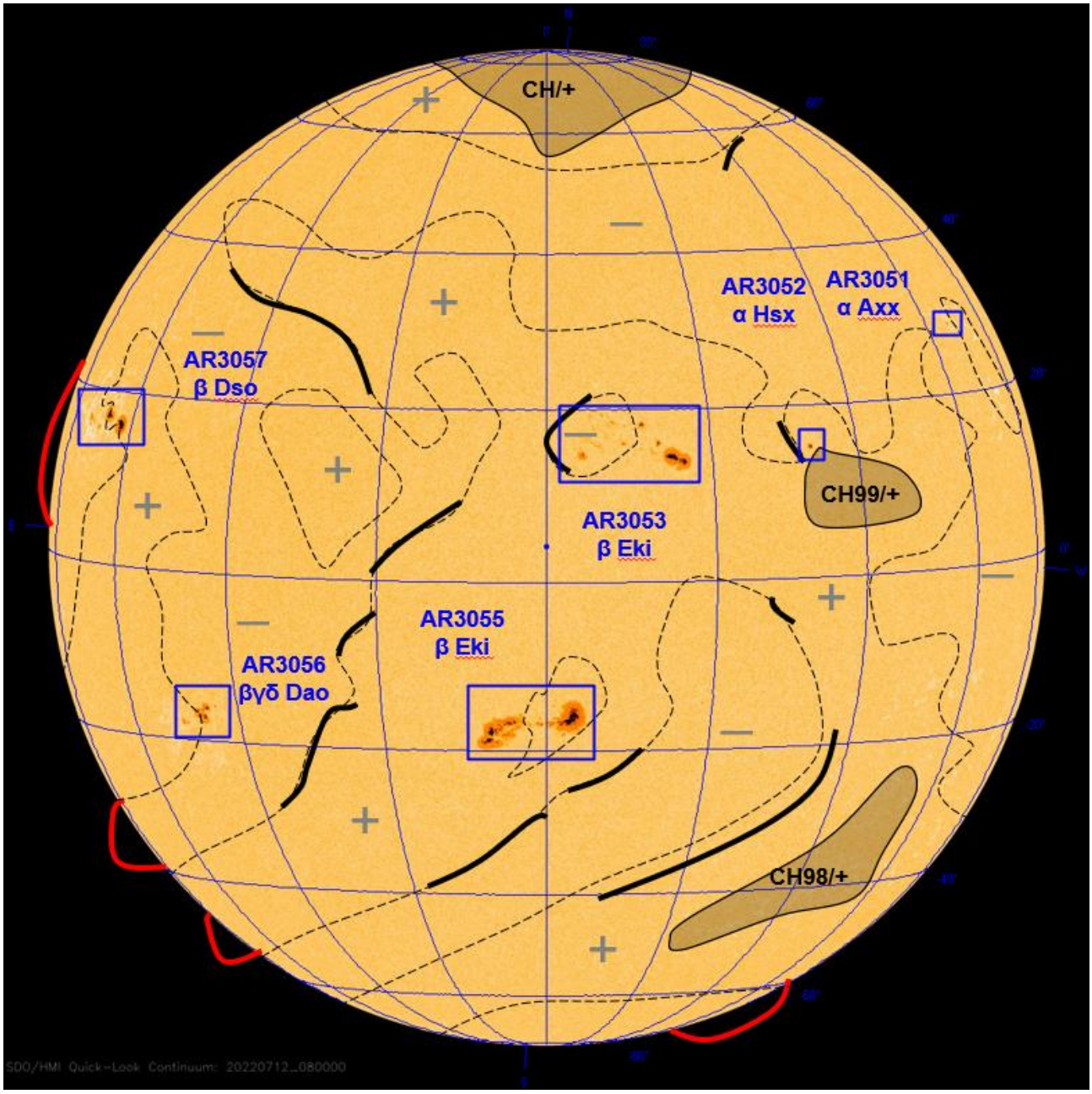
Figure 1. Solar Analysis Valid 12/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth may receive a glancing blow from a CME that left the Sun on the 09 July. While the bulk of the ejecta is expected to miss behind Earth's orbit, a glancing blow is considered likely and its arrival is estimated to be late on Day 1 (12 July) or early on Day 2 (13 July).

The solar wind is currently at slightly elevated levels, likely under the influence of the high speed stream originating from CH99/+, but also perhaps with some transient influence. CH99 is a recurring feature that generated speeds of 600 km/s on the previous rotation. However, due to its smaller size and fragmentation in the intervening month, it is hard to envisage similar speeds will be achieved this time around. Any increase in the HSS may be superseded by the expected arrival of the CME, perhaps increasing the solar wind to strong levels. Otherwise, winds are expected to reach elevated levels on Days 1 and 2 before slowly decreasing. CH98/+ may contribute to this enhancement however its input is considered minor, being further away from the Earth ecliptic latitude.

Overall geomagnetic activity is expected to be Unsettled to Active, with a Chance of G1/Minor Storms and a slight chance of G2/Moderate Storms with any CME effects. Geomagnetic activity then returning to mostly Quiet levels on Days 3 and 4 (14-15 July).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	50	1	1
Strong	G3	No	2	2	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
10/0500	Partial	AR3052	NE quadrant	918 km/s	12/2200 UTC +/- 6 hrs	Moderate shock

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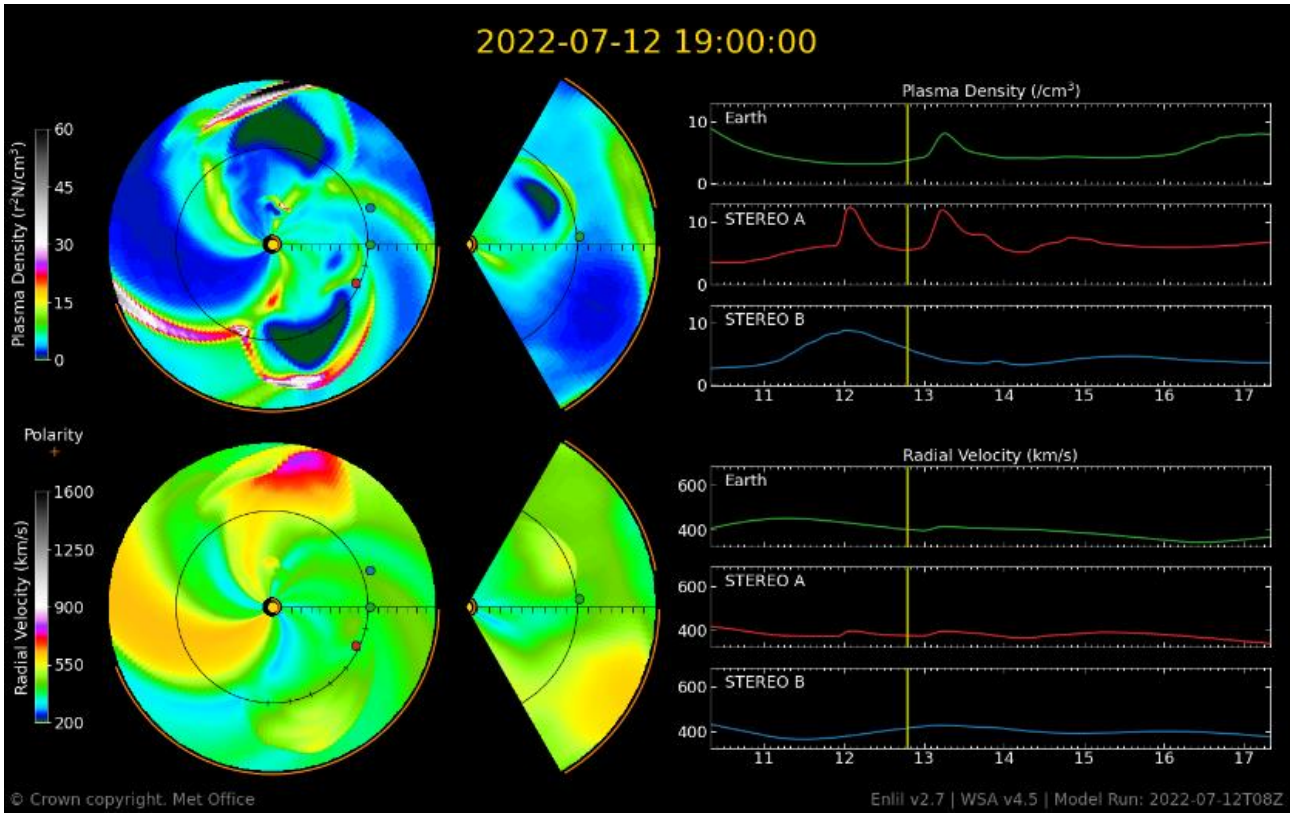
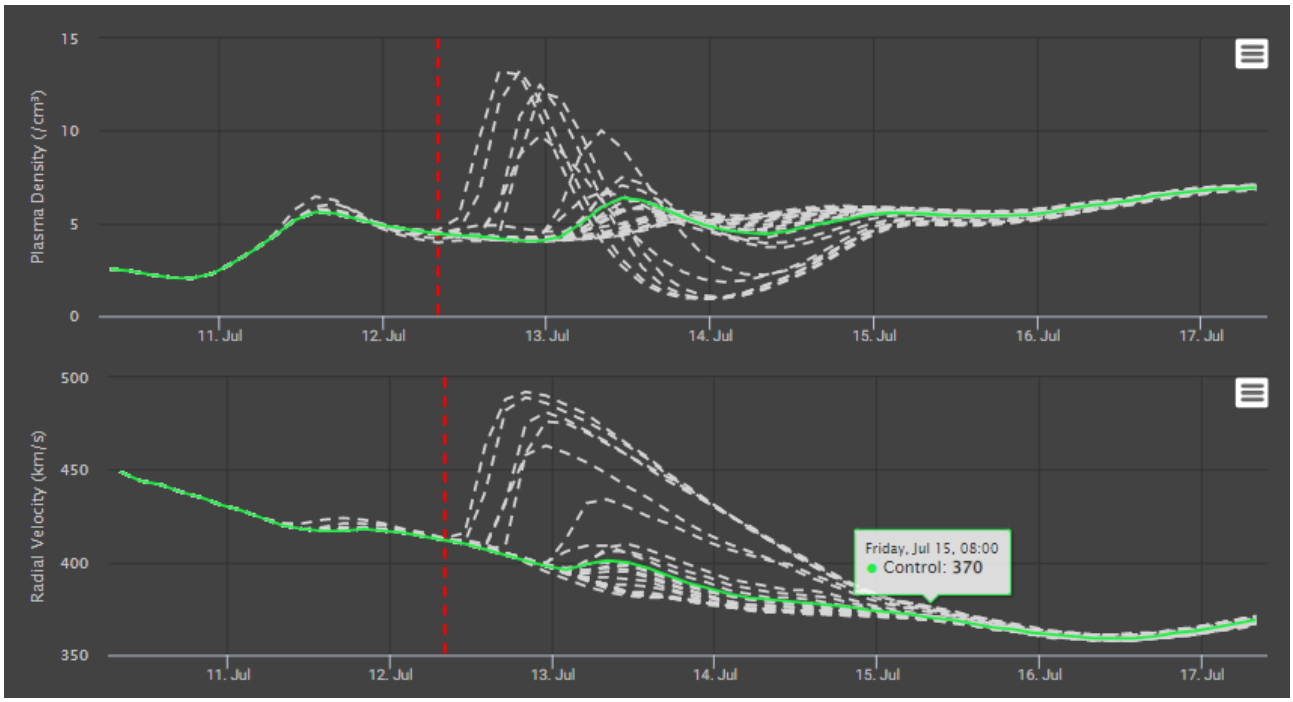
Figure 2: Enlil model and ensemble, showing a possible CME arrival late Day 1 or early Day 2 (12-13 July)





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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

Solar activity has been Low in the last 24 hours, with only C-class flares observed. Background x-ray flux is now in the C-class category however.
There are six numbered sunspots on the disc. AR3056 (Dao/Beta-gamma-delta) has been the most active region, with a small delta region in its leading spot. AR3055 and AR3053 (both Eki/Beta) are both large regions but with limited magnetic complexity. AR3057 is still near the NE limb and as such is difficult to classify, but may have some slight magnetic complexity. The remaining two regions are small and simple, with AR3046 having now faded.
Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	15	15	15	15

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is now back to background levels, after it became slightly elevated on the 09 July (in response to a C8 flare). There is a slight chance of S1 or greater, due to the presence of two relatively large sunspot regions on the centre disc. The risk will increase slightly through the period as these regions transit the western hemisphere.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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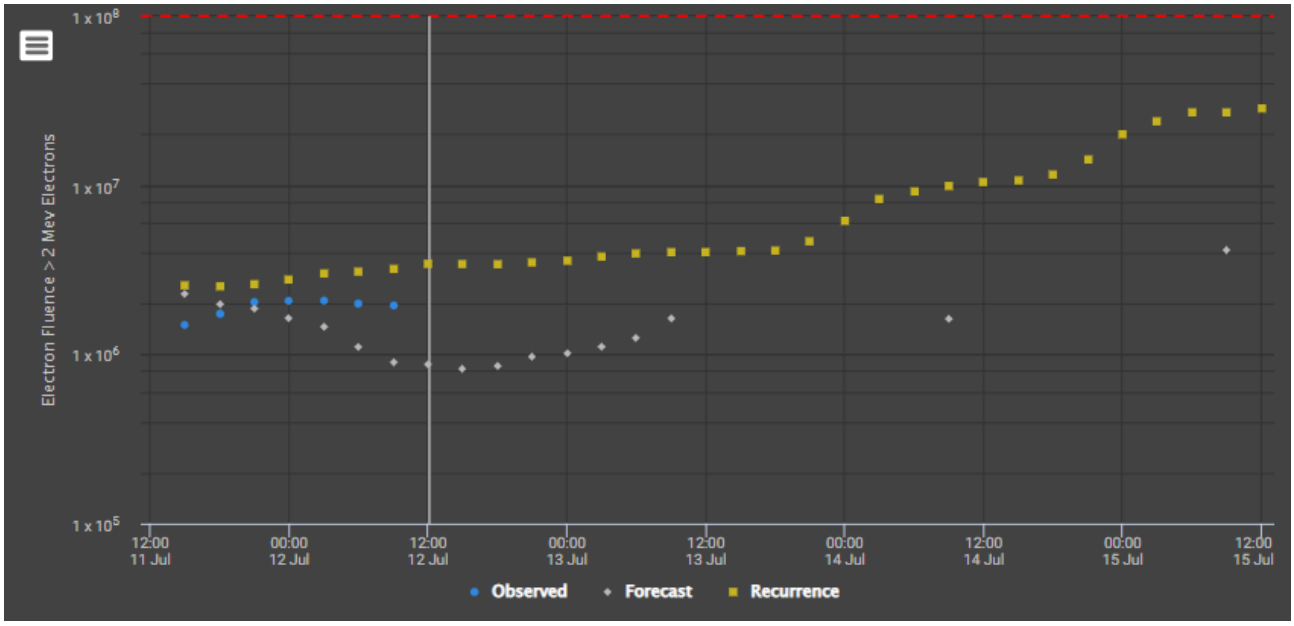
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is currently at background levels. CH99 is currently bringing an increase in wind speeds which may cause some electron charging, however the anticipated CME arrival later on Day 1 or early on Day 2 (12-13 July) is likely to cause a temporary suppression in electron levels. As such, a rise is possible later in the period after CME effects have waned, but this is low confidence.

The corresponding fluence may show an increasing trend later in the period, but is unlikely to exceed the Active threshold (1e8 integrated pfu).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM model showing a fairly steady trend.



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